

What is claimed is:

1. A film forming method comprising the steps of:
preparing a substrate; and

5 forming a metal silicate film on the substrate by a
CVD process using a gas of metal alkoxide and a gas of
silicon hydride,

10 wherein the step of forming the film is performed by
setting a temperature of the substrate to be higher than or
equal to a temperature at which the metal alkoxide is
15 decomposed into metal hydroxide and a specific intermediate,
and lower than a self-decomposition temperature of the
silicon hydride.

15 2. The method of claim 1, wherein the gas of the metal
alkoxide has a tertiary butoxyl radical as a ligand thereof.

3. The method of claim 2, wherein the intermediate is
isobutylene.

20 4. The method of claim 2, wherein the metal alkoxide is
HTB.

25 5. The method of claim 4, wherein the temperature of the
substrate in the step of forming the film is higher than or
equal to 350 °C.

6. The method of claim 1, wherein the silicon hydride is disilane.

5 7. The method of claim 6, wherein the temperature of the substrate in the step of forming the film is lower than or equal to 450 °C.

8. A film forming method comprising the steps of:

10 preparing a substrate; and

forming a hafnium silicate film on the substrate by a CVD process using a HTB gas and a disilane gas,

wherein the step of forming the film is performed by setting a temperature of the substrate to be higher than or equal to 350 °C and lower than or equal to 450 °C.

9. A film forming apparatus for forming a metal silicate film on a substrate by a CVD process using a gas of metal alkoxide and a gas of silicon hydride, the apparatus comprising:

a process chamber for accommodating therein a substrate;

a heater for heating the substrate in the process chamber;

25 a gas supply system having a vaporizing unit for vaporizing metal alkoxide source material into a gas of

metal alkoxide, the gas supply system for separately supplying the gas of the metal alkoxide and the gas of the silicon hydride to the process chamber;

5 a shower head for diffusing the gas of metal alkoxide and the gas of silicon hydride, each being supplied from the gas supply system, into the process chamber; and

10 a controller for controlling the heater such that the temperature of the substrate in the process chamber in the step of forming the film is set to be higher than or equal to a temperature at which the metal alkoxide is decomposed into metal hydroxide and a specific intermediate and lower than a self-decomposition temperature of the silicon hydride.

15 10. The apparatus of claim 9, wherein the metal alkoxide has a tertiary butoxyl radical as a ligand thereof.

11. The apparatus of claim 10, wherein the intermediate is isobutylene.

20 12. The apparatus of claim 10, wherein the metal alkoxide is HTB.

25 13. The apparatus of claim 12, wherein the temperature controller controls the temperature of the substrate when forming the film to be higher than or equal to 350 °C.

14. The apparatus of claim 9, wherein the silicon hydride is disilane.

15. The apparatus of claim 14, wherein the temperature 5 controller controls the temperature of the substrate when forming the film to be lower than or equal to 450 °C.

16. The apparatus of claim 9, wherein the shower head is configured to separately supply the gas of metal alkoxide 10 and the gas of silicon hydride into the process chamber.

17. A film forming apparatus for forming a hafnium silicate film on a substrate by a CVD process using an HTB gas and a disilane gas, comprising:

15 a process chamber for accommodating therein a substrate;

a heater for heating the substrate in the process chamber;

20 a gas supply system having a vaporizing unit for vaporizing an HTB liquid into an HTB gas, the gas supply system separately supplying the HTB gas and the disilane gas to the process chamber;

25 a shower head for diffusing the HTB gas and the disilane gas, each being supplied from the gas supply system, into the process chamber; and

a controller for controlling the heater such that the

temperature of the substrate in the process chamber in the step of forming the film is set to be higher than or equal to 350 °C and lower than or equal to 450 °C.

5 18. The apparatus of claim 17, wherein the shower head is configured to separately supply the HTB gas and the disilane gas into the process chamber.

10 19. A method for manufacturing a semiconductor device, comprising the steps of:

preparing a silicon substrate;

forming a silicon oxide film functioning as a base insulating film on the silicon substrate;

15 forming a metal silicate film functioning as a gate insulating film on the silicon oxide film by a CVD process using a gas of metal alkoxide and a gas of silicon hydride; and

forming a gate electrode on the metal silicate film,

20 wherein the step of forming the metal silicate film is performed by setting a temperature of the substrate to be higher than or equal to a temperature at which the metal alkoxide is decomposed into metal hydroxide and a specific intermediate and lower than a self-decomposition temperature of the silicon hydride.

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20. The manufacturing method of claim 19, wherein the step

of forming the silicon oxide film is performed by oxidizing a surface of the silicon substrate with UV-excited oxygen radicals.